# SPECIALTY CARBONS FOR **RUBBER COMPOUNDS**

ENSACO® Carbon Black **TIMREX**® Graphite







IMERYS GRAPHITES & CONDUCTIVE CARBON BLACKS FUNCTIONAL ADDITIVES FOR YOUR RUBBER COMPOUNDS

### CARBON SOLUTIONS FOR RUBBER APPLICATIONS

Imerys has a wide range of specialty carbon based additives to give rubber compounds the properties required for various applications.

- Selectrical conductivity
- 🔗 Thermal conductivity
- 🔗 Self lubrication
- 🧭 Gas barrier





# SOLUTIONS FOR ELECTRICAL CONDUCTIVITY

### **ENSACO® CONDUCTIVE CARBON BLACKS**

**ENSACO**<sup>®</sup> is a special family of conductive carbon blacks, produced through a proprietary method, that delivers extremely pure products (low metal and sulphur content). They are characterised by a unique combination of high structure and low surface area.

In addition, they have a low moisture uptake which prevents surface defects on the final product. These qualities make ENSACO<sup>®</sup> the ideal additive for rubbers where high purity and / or high surface smoothness is required.

**ENSACO**<sup>®</sup> electrically conductive carbon blacks are highly branched carbons which enable conductivity at low loadings. Their unique combination of high structure and low surface area make them easier to disperse and process than other conductive carbon blacks.



Applications for electrically conductive rubbers include:

- $\ensuremath{\boxdot}$  Automotive fuel hoses
- ⊘ Transmission belts
- ⊘ Conveyor belts
- $\bigcirc$  Power cable accessories

- Solution Conductive profiles and seals
- 🔗 Anti-static flooring

	SUPER CONDUCTIVE FURNACE BLACK N472	ENSACO® 250G	ENSACO® 260G	ENSACO® 350G
Production process	Furnace process	Imerys process	Imerys process	Imerys process
Properties	HS/HSA	HS/LSA	HS/LSA	VHS/VHSA
OAN structure (ml/100g)	178	190	190	320
BET surface area (m²/g)	250	65	70	770
Ash content (%)	0.03	0.01	0.01	0.02
Grit 325 mesh 45 µm (ppm)	< 20	< 2	< 2	< 10
Sulphur content (ppm)	4700	100	100	150
Conductivity	++	+++	+++	++++
Dispersion	+	+++	+++	-
Purity	+	+++	+++	++(+)

HS = High structure, VHS = Very high structure, LSA = Low surface area, HSA = High surface area, VHSA = Very high surface area

# **KEY BENEFITS**

## ADDING ENSACO® TO NITRILE BUTADIENE RUBBER (NBR) RESULTS IN:

igodot Easy compounding and processing

𝔅 Excellent extrusion properties

Advantages of ENSACO<sup>®</sup> 250G (high structure and low surface area) compared to N472 (high structure and high surface area):

- $\odot$  Lower Mooney viscosity
- igodot Higher elongation at break
- ⊗ Lower moduli
- 𝔄 Tensile strength
- 𝔄 Higher tear strength
- 𝔄 Lower hardness
- 𝔅 Same curing properties
- 𝔄 Lower resistivity



COMPOUND FORMULATION (PHR)	А	В	С	D		
NBR NT 3945	100	100	100	100		
ENSACO <sup>®</sup> 250G	20	25	30	-		
SCF N472	-	-	-	25		
N550	40	40	40	40		
ZnO	4	4	4	4		
Stearic acid	0.5	0.5	0.5	0.5		
DOP	30	30	30	30		
Sulphur	0.4	0.4	0.4	0.4		
Methyl tuads	2	2	2	2		
Amax	2	2	2	2		
ML(1 + 4) at 100 °C (MU)	38.1	45.7	50.6	47.2		
Rheometer at 155°C						
Min. torque (dNm)	1.00	1.39	1.61	1.33		
Max. torque (dNm)	20.57	22.62	24.06	22.86		
Delta torque (dNm)	19.57	21.23	22.45	22.53		
t90 (min)	11.82	11.46	11.83	11.37		
Hardness shore A	67.9 +/- 0.2	70.9 +/- 0.3	72.8 +/- 0.2	72.2 +/- 0.5		
Stress strain (S2, 500 mm/min)						
Tensile strength (MPa)	13.2 +/- 0.3	13.8 +/- 0.6	13.7 +/- 0.7	14.8 +/- 0.3		
Elongation at break (%)	354 +/- 10	339 +/- 24	335 +/- 23	311 +/- 10		
Modulus 100% (MPa)	3.5 +/- 0.0	3.9 +/- 0.1	4.2 +/- 0.1	4.6 +/- 0.1		
Modulus 200% (MPa)	7.7 +/- 0.0	8.6 +/- 0.1	9.0 +/- 0.1	10.3 +/- 0.2		
Modulus 300% (MPa)	11.6 +/- 0.1	12.6 +/- 0.2	12.8 +/- 0.1	14.4 +/- 0.2		
Tear strength (MPa)	30.2	32.4	29.7	31.8		
Resistivity (Ohm.cm)	130	79	44	360		

# **KEY BENEFITS**

## ADDING ENSACO® TO ETHYLENE PROPYLENE DIENE MONOMER (EPDM) RESULTS IN:

ENSACO<sup>®</sup> 250G (high structure and low surface area) compared to N472 (high structure and high surface area):

- 𝔅 Higher conductivity at lower loading
- igodot Easy dispersion
- $\,\,\,\odot\,\,$  Lower energy needed for mixing
- ${}^{\scriptsize{\scriptsize{\bigcirc}}}$  Lower resistivity



Compound formulation: EPDM OE-130; ZNO-5; Peroxide-5

Volume resistivity of EPDM with various

concentrations of carbon black





# **KEY BENEFITS**

## ADDING ENSACO® TO FLUORO-RUBBER (FKM) RESULTS IN:

- 𝔄 Low viscosity
- Section Excellent compounding and extrusion
- ✓ Required mechanical properties maintained
- 𝔄 Low vulcanisation time

The formulation with 20 PHR N472 with high structure, higher surface area and lower purity compared to ENSACO® resulted in incomplete vulcanisation.

COMPOUND FORMULATION (PHR)	A HIGH STRUCTURE/ LOW SURFACE AREA	B HIGH STRUCTURE/ HIGH SURFACE AREA			
VITON A-32J	100	100			
ENSACO <sup>®</sup> 250G	20	0			
N472	0	20			
MgO	3	3			
Ca(OH) <sub>2</sub>	3	3			
VPA-2	1	1			
Uncured properties					
Mooney viscosity ML(1+10'), 100°C	87.7	107.3			
Rheometry ODR 177°C (max 12 min)	-	_			
ts2 (min)	2.6	6.6			
tc90 (min)	4.4	20.4			
Cured properties (177°C, 10 min)					
Volume resistivity (Ohm.cm)	27	26			
Compression set (%)	44.9	65			
Module 100% (kg/cm <sup>2</sup> )	60	39			
Module 300% (kg/cm <sup>2</sup> )	127	52			
Tensile strength (kg/cm²)	140	54			
Elongation at break (%)	370	560			
Hardness (shore A)	83	82			



Courtesy of DuPont Performance Elastomers, Japan.

# **KEY BENEFITS**

#### HIGH PURITY MAKES ENSACO® IDEAL FOR TRACE ELEMENT SENSITIVE POLYMERS SUCH AS SILICONES —

Due to its low surface oxygen content, adding **ENSACO® 250G** results in lower peroxide curing inhibition compared to other conductive carbon blacks.

**ENSACO**<sup>®</sup> is suitable for platinum cured silicone due to the very low level of sulphur and metal impurities.

COMPOUND FORMULATION (PHR)					
ENSACO <sup>®</sup> content PHR (weight%)	16 PHR 14%	20 PHR 17%	37.5 PHR 27%		
Rheometer MDR 180°C , 6 min					
MH (lb.in)	16.3	17.0	21.1		
ML (lb.in)	1.0	1.2	3.3		
delta (lb.in)	15.3	15.8	17.8		
ts2 (min)	00:32	00:34	00:38		
t50 (min)	01:05	01:15	01:38		
t90 (min)	02:44	03:10	03:51		
Volume resistivity (Ohm.cm)	7,3.10 <sup>8</sup>	830	13		

#### Percolation curve of ENSACO<sup>®</sup> 250G in slicone







## SOLUTIONS FOR THERMAL MANAGEMENT

Imerys has a complete offer of carbon based additves for rubber compounds where thermal conductivitiy is essential. For example:

- Subbers used in applications where heat is generated and needs to be effectively dissipated.
- Where thermally conductive additives will improve processing by reducing the curing time, and/or enabling a more homogeneous temperature profile within a rubber part.

**ENSACO**<sup>®</sup> conductive carbon blacks are characterised by high degree of graphitisation and an isotropic nature making them an excellent choice to provide thermal conductivity, especially in the through-plane direction.

For high thermal conductivity performance TIMREX<sup>®</sup> graphites are the ideal solution with TIMREX<sup>®</sup> C-THERM<sup>™</sup> resulting in the highest thermal conductivity at low loading. Examples of rubber applications requiring thermal conductivity include:

- ✓ Seals and gaskets
- 𝔄 Heat exchangers
- 𝔅 Rubber parts operating at high temperatures

Comparison of In-plane thermal conductivity of SBR compounds with carbon additives (50PHR)



IRB 7: A market reference N330

ENSACO<sup>®</sup> 250G: High structure / low surface area conductive carbon black

TIMREX® KS4: Fine shaped synthetic graphite, d90= 4  $\mu m$ 

TIMREX<sup>®</sup> C-THERM<sup>™</sup> 002: High aspect ratio graphite, d90= 80 μm





# IMERYS GRAPHITE & CARBON – A STRONG, INNOVATIVE COMPANY.





With production sites in Europe, Canada and Japan and sales offices in Europe, America and throughout Asia we can ensure security of supply and an optimal customer experience.

## **OUR EXPERTISE**

Imerys Graphite & Carbon is a global company focused on delivering carbon based solutions for manufacturing and industry.

We have over 100 years of experience in the development and production of a wide variety of high quality synthetic and natural graphite powders, conductive carbon blacks, silicon carbide and water based dispersions for various end applications including, but not limited to:

- ℅ Lithium-ion Batteries
- ⊗ Alkaline Batteries
- ✓ Lead Acid Batteries
- Sconductive Polymers, Plastics and Rubbers
- ⊘ Carbon Brushes
- Solution Brake Pads and Clutches
- Solution Powder Metallurgy and Hard Metals

Our team of over 500 experienced professionals ensures we deliver optimal solutions for the technical challenges faced by our customers making us the market leader for:

- Conductive carbon blacks and graphites for lithium-ion batteries
- ♂ Graphites for alkaline batteries
- 𝔅 Graphites for resin bonded carbon brushes
- Solutive carbon blacks for conductive polymers

#### **IMERYS GROUP**

Imerys Graphite & Carbon belongs to Imerys Group, the world leading supplier in mineral based specialties for industry.

The Group draws on its understanding of applications, technological knowledge and expertise in material science to deliver solutions based on beneficiation of its mineral resources, synthetic minerals and formulations. These contribute essential properties to customers' products and their performance, including heat resistance, hardness, conductivity, opacity, durability, purity, lightness, filtration, absorption and water repellency.

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